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(54) Combination connector assembly.

(57) A pair of holding members (1, 6) are provided for removably holding female and/or male connectors (7, 2) in plurality therein. A cover (8) is removably attached to the second holding member (6) on the wire fitting side, the cover (8) being provided with a hold-down portion. Respective one ends of the connectors held in one of the holding members are urged toward the other holding member by means of the hold-down portion. The one holding member (6) has a pin (5) formed thereon for lockingly engage a cam groove (10). A lever (9) formed with the cam groove is rotatably provided on the other holding member. The lever is rotated while the pin is in engagement with the cam groove, whereby plural pairs of connectors held in position within respective holding members are coupled together in one operation.

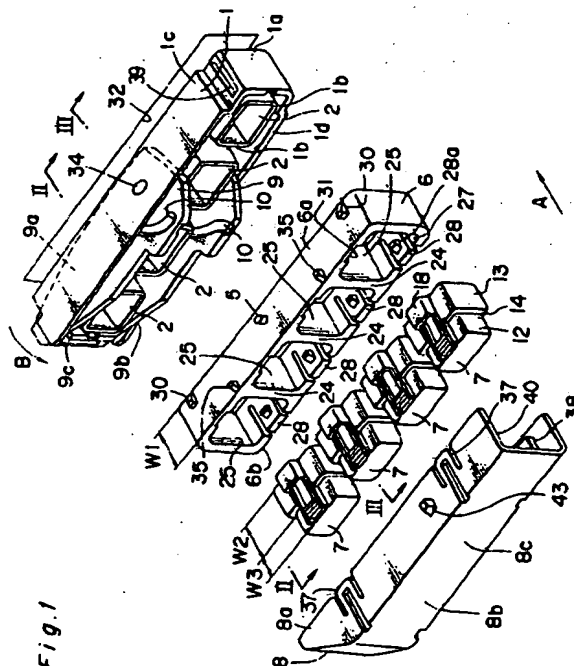


Fig. 1

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the first embodiment;

Fig. 4 is a sectional view showing an essential portion of a female connector as held in position in a holding member; and

Fig. 5 is an exploded view in perspective showing a second embodiment of the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will now be described in further detail with respect to embodiments thereof with reference to the attached drawings.

Figs. 1 through 4 illustrate a first embodiment of the invention which is designed for coupling a wiring harness connector unit (7) to a printed board connector unit (2).

As shown in Figs. 3 and 4, in the printed board connector side, a male connector housing 1 has a plurality of connector sections 2 serving as terminal receiving chambers arranged side by side, where each connector section receives male tabs 4 extending from a printed board 3 (see Figs. 2 and 3). In this embodiment, the connector housing 1 per se serves concurrently as a holding member for holding the male connectors 2.

In the first embodiment, as shown in Fig. 1, a plurality of female connectors 7 for connecting wiring harnesses are held in place in a holding member 6. The holding member 6 has a pin 5 projected therefrom, and a cover 8 for preventing the female connectors 7 from slipping off when the cover 8 is removably mounted to the holding member 6. The male connector housing 1 which serves concurrently as a holding member is provided with a lever 9 having a cam groove 10 formed therein. The cam groove 10 is lockingly engaged by the pin 5 projecting from the holding member 6. With this engaged arrangement between the pin 5 and the cam groove 10, by turning the lever 9, the plurality of female connectors 7 held in the holding member 6 can be respectively fitted in one operation into the connector sections 2 defined in the male connector housing 1 so that the male tabs 4 are engaged and connected with terminals 11 provided in the respective female connectors 7.

Nextly, the construction of the foregoing components will be described in detail.

Each of the female connectors 7 is provided with female terminals 11 which respectively match circuit current values. The female connectors 7 are each contoured like a structure having larger and smaller two-level rectangular frames arranged in continuation. More specifically, each female connector 7 has a smaller frame 12 positioned on the wire fitting side and a larger frame 13 positioned on the connector coupling side, with a locking stepped portion 14 formed around the peripheral edge portion between the smaller and larger frames 12 and 13 in each con-

connector 7. The locking stepped portion 14 is adapted to be lockingly engaged by a protrusion 28a formed on a resilient locking piece 28 provided in the holding member 6 as to be described hereinafter, so that each of the respective female connectors 7 can be held in position within the holding member 6.

On the top of the connector coupling side frame 13 is provided a locking arm 16 (see Fig. 4) formed integrally therewith, and on the top of the arm 16 there is provided a lock protection wall 18 projecting in a U-shape pattern.

The connector coupling side frame 13 constitutes an outer wall of the female connector 7, and in the interior of the frame 13 there is formed an inner frame 21 defining a terminal housing chamber 20, with a space S for coupling a male connector 2 therewith. The terminal housing chamber 20 extends integrally with the wire fitting side frame 12 and the inner frame 21 is formed in continuation with the terminal housing chamber 20.

In the first embodiment, the interior of each frame 12 and inner frame 21 defines a plurality of two-level terminal housing chambers 20, upper and lower (two chambers for each level) in which are disposed four terminals in all for wire connection. Each of the terminal housing chambers 20 has an opening on the wire fitting side and has, on the connector coupling side, a through-hole 22 for male tab insertion.

The holding member 6 in which four female connectors 7 are housed and held in position consists of a rectangular frame which is longitudinally elongate and is open on both the front and rear sides, and has, in its interior, longitudinally equidistantly spaced partition walls 24 formed integrally therewith which define four connector holding chambers 25 arranged in parallel.

Each connector holding chamber 25 has, at its bottom 27, a resilient piece 28 oriented toward corresponding female connector 7, and the resilient piece 28 has a protrusion 28a formed on its inner upper portion. Therefore, when the female connector 7 is pushed forward in a forward direction shown by an arrow A in Fig. 1, the connector coupling side larger frame 13 thereof rides over the resilient locking piece 28 for entry into the connector holding chamber 25 until the protrusion 28a on the resilient locking piece 28 lockingly engages the locking stepped portion 14 at the border between the larger frame 13 and the wire fitting side smaller frame 12, so that the female connector 7 is primarily held in position within the connector holding chamber 25 defined in the holding member 6, as being prevented from slipping off the holding member 6.

Further, the holding member 6 has a front stop wall 29 for preventing the female connectors 7 from frontwardly sliding off.

The ceiling of each connector holding chamber 25 is recessed to form a groove 31 for receiving a lock

protection wall 18 formed on the top of each corresponding female connector 7.

The transverse width W1 of the holding member 6 is set generally equal to the sum of the width W2 of the connector coupling side frame 13 and the width W3 of the wire fitting side frame 12 of each female connector (W1 = W2 + W3) so that each female connector 7 can be completely housed in the interior of respective connector holding chambers 25 of the holding member 6.

The holding member 6 has upper and lower wall portions 6a, 6b each having a protrusion pin 5 outwardly protruded on the center portion of the outer side thereof, the pins 5 being releasably engageable with cam grooves 10 of the lever 9 provided in the male connector housing 1 which will be described hereinafter.

The upper and lower wall portions 6a, 6b are provided at locations close to the cover 8 with a pair of protrusions 35 for locking the cover 8. Further, the upper wall portion 6a is formed at locations closer to the male connector housing 1 with a pair of protrusions 30 for tentatively locking the male connector housing 1.

Male connectors 2 which are to mate with the female connectors 7 held in the holding member 6 are formed integrally with one male connector housing 1 which serves concurrently as a holding member as mentioned before. More specifically, the male connector housing 1 has, at the rear side of a planar vertical wall portion 1a thereof, four cylindrical frames 1b, each having a rectangular shape in section, which are formed integrally therewith and arranged at predetermined intervals, the cylindrical frames 1b each being open at the rear side and closed at front and lateral sides to form a connector section 2 in the form of a box-shaped housing.

The four connector sections 2 arranged in parallel in the male connector housing 1 as above described are each so sized as to be engageably fitted in the space S between the outer frame of the connector coupling side frame 13 of the female connector 7 held in corresponding connector holding chamber 25 of the holding member 6 and the inner frame 20 of the frame 13. The width W4 (see Fig. 2) of a projecting portion of each connector section 2 is sized generally equal to the width W2 of the connector coupling side frame 13 of corresponding female connector 7. The upper wall portion of the connector housing 1 is formed with a slit 39.

The frontside of the vertical wall portion 1a of the male connector housing 1 is secured to a unit for housing the printed board 3 (only an opening 32 of the unit is shown in Fig. 1). The male tabs 4 connected to the circuitry of the printed board 3 housed in the unit are projected through the vertical wall portion 1a into each of the four connector sections 2, as shown in Figs. 2 and 3. In the first embodiment, each female

connector 7 is quadripolar and, therefore, four male tabs 4 are projected into each connector section 2 in four directions. The number of terminals in each female connector 7 is variable and accordingly the number of connecting male tabs 4 is variable as well.

The lever 9 to be attached to the holding member 6 is U-shaped such that upper and lower frame portions 9a, 9b thereof are disposed respectively in spaces defined between inner sides of upper and lower wall portions 1c, 1d of the male connector housing 1 and the cylindrical frame 1b of the connector sections 2, the upper and lower frame portions 9a, 9b being interconnected at one end by a bar-like vertical frame portion 9c. The upper and lower frame portions 9a, 9b are provided at the other end with a pin-shaped turning shaft 9d extending therethrough which is loosely fitted in a shaft hole 34 formed centrally through the upper and lower walls 1c, 1d of the male connector 1 so that the lever 9 is rotatable about the turning shaft 9d. The upper and lower frame portions 9a, 9b are each formed with a generally semi-annular cam groove 10 located around the turning shaft 9d.

In the first embodiment, there is provided a cover 8 for preventing slip-off of female connectors 7 held in the holding member 6. The cover 8 has upper and lower frames 8a, 8b and a rear frame 8c, which is U-shaped in section with front side open. The upper and lower frames 8a, 8b of the cover 8 are each provided with a pair of locking arms 37 projecting forward which are lockingly engageable with corresponding protrusions 35 of the holding member 6 to fix the cover 8 with the holding member 6.

On the inner side of the rear frame 8c and at a portion opposite to the female connectors 7 there is formed a hold-down portion 38 adapted to abut upper and lower surface portions of the wire fitting side frame portions 12 of the female connectors 7 so as to secondarily hold the female connectors 7 when held within the holding member 6. At one end of the cover 8 as viewed longitudinally thereof, there is provided an opening 40 which serves as a drawing port of wires connected to individual female connectors 7.

Nextly, the manner of assembling operation for the above described combination connector assembly will be explained.

The four female connectors 7 are first inserted into respective connector holding chambers 25 of the holding member 6 and the protrusion 28a formed on the resilient locking pieces 28 are brought into engagement with the corresponding locking stepped portions 14. Then, the cover 8 is attached to the rear portion of the holding member 6 and locked in position by causing the locking arms 37 to be engaged with the protrusions 35. Thus, the female connectors 7 are held in engagement with the resilient locking pieces 28 and, in addition, pressed at the rear side by the hold-down portion 38, so that the female connectors 7 are securely held in position within the connec-

tor holding chambers 25.

Nextly, the holding member 6 is moved toward the rear side of the male connector housing 1 and, as shown in Figs. 2 and 3, the four connector sections 2 are inserted into the corresponding openings located in front of the holding member 6. The cylindrical frames 1b which constitute housings for respective connector sections 2 are fitted into spaces S between individual female connectors 7, and the projections 30 of the holding member 6 come into locking engagement with slits 39 of the male connector housing 1. In this tentatively locked state, the male tabs 4 are positioned at inlet ends of the through-holes 22 for male tabs which are open at respective rear ends of female connectors 7. At this time, the pin 5 of the holding member 6 is located at the rear end of the cam groove 10 for the lever 9 mounted to the male connector housing 1.

Subsequently, the lever 9 is manipulated to start turning in the direction shown by the arrow B in Fig. 1. Through the removable rotation of the lever 9, the pin 5 moves along the cam groove 10 to move the holding member 6 toward the male connector housing 1. As a result, the holding member 6 moves from its position as shown in Figs. 2 and 3 further rightward in the figures so that male tabs 4 are allowed to pass through the through-holes 22 of female connectors 7 for entry into the interior of female terminals 11, electrical connection being thus established. At the time when the male tabs 4 are completely fitted into the female terminals 11, the connector coupling side frame portions 12 of the female connectors 7 come into the state of mating with the cylindrical frames 1b of the connector sections 2.

As described above, the female connectors 7 go into engagement with the resilient pieces 28 thereby to be primarily held in position within the holding member 6 and, in addition, the female connectors 7 are pressed, at their rear end side, against the forward stop wall 29 by the hold-down portion 38 of the cover 8, whereby they are secondarily held in position. Therefore, even when the female connectors 7 are not held in position by means of the resilient pieces 28, they can be positively forced into the holding member 6 by mounting the cover 8 to the holding member 6, being thus brought into engagement with the resilient pieces 28. When the female connectors 7 are engaged in the connector sections 2, it is unlikely that they become tilted to go out of alignment, it being thus possible to achieve precise male-female connector coupling.

At the end of coupling operation, locking stepped portions (not shown) provided at the inner side of the upper and lower frame portions 9a, 9b of the lever 9 go into engagement with locking projections 43 formed on the cover 8 thereby to fix the lever 9.

In the first embodiment, the male connector housing 1 fixed to the electronic unit is provided with

a lever 9. As stated above, therefore, once the male and female connectors are coupled to securely fix the lever 9, there is no possibility of the lever 9 being caused to move by any external force acting on wires.

Nextly, a second embodiment of the present invention will be described with reference to Fig. 5.

In this second embodiment, a cover 45 includes a frame portion 46, and a lid portion 48 connected with the frame portion 46 through a hinge portion 47.

The frame portion 46 is a longitudinally elongate rectangular frame which has openings at its both front and rear sides. The frame portion 46 has also an opening 49 at one longitudinal end through which wires connected to female terminals 11 can be drawn. In the frame portion 46 there are provided rectangular pusher portions 50 positioned to oppose female connectors 7 such that the pusher portions 50 are pressed against the rear ends of the female connectors 7. Further, upper and lower portions of the frame portion 46 are each formed with a pair of projections 51 engageable with locking arms 52 provided on the lid portion 48.

In assembling the combination connector of this second embodiment, the female connectors 7 are first held in the holding member 6, and then the locking arms 37 on the frame portion 46 of the cover 45 are brought into engagement with the projections 35 of the holding member 6 so as to attach the frame portion 46 to the holding member 6. In this condition, wires of female terminals 11 provided at individual female connectors 7 are drawn through the side opening 49 of the frame portion 46. At this time, it is possible to determine whether the female connectors 7 are precisely held in position within the holding member 6. Then, the lid portion 48 is rotated at hinge 47 to cause the locking arms 52 to engage the projections 51 thereby to close the rear side opening of the frame portion 46, as shown by an arrow C in Fig. 5. Thereafter, in same manner as in the first embodiment, the male connector housing 1 is coupled to the female connectors 7 held in the holding member 6.

In the second embodiment, as described above, female connectors 7 can be visually confirmed with the cover 45 attached to the holding member 6. This provides for accurate coupling of female connectors 7 to the male connector housing 1 and easy operation of wire drawing from the opening 49.

Other features and functions of the second embodiment are identical with those of the first embodiment and, therefore, description thereof is omitted, it being only noted that identical members are designated by identical reference numerals.

The scope of the present invention is not limited to the foregoing embodiments, and the construction of the device may be modified in various ways.

For example, the lever may be attached to the holding member or the cover, and the pin to be received in the cam grooves of the lever may be provided

ed at the male connector housing side.

In the foregoing embodiments, the resilient locking piece provided in each connector holding chamber of the holding member is only one in number, but alternatively a pair of resilient pieces, right and left or upper and lower, may be provided to enable connectors to be held more accurately in corresponding connector holding chambers.

Moreover, in the male-female connectors provided with pressure wiring connectors attached to wirings, the male connector housing may be composed of a plurality of connector units similarly to those of the female connectors, where the plurality of connector units are housed in one holding member and the connector units held in the holding member are combined by means of a lever.

As is apparent from the foregoing description, according to the present invention it is possible to manually perform connector coupling without requiring large operating effort and any special tool, since a holding member in which a plurality of connectors are housed and held in position can be brought into engagement by means of a lever. Further, the arrangement is unlikely to cause any impact at the time of coupling connectors, which fact permits the connector assembly to be mounted to an electronic unit or the like without any adverse effect.

According to the present invention, a cover is removably mounted to the holding member at the wire fitting side such that the cover is provided with a hold-down portion which serves to urge connectors held within the holding member against the wall of the holding member. This permits the connectors to be securely held within the connector holding member. Therefore, at the time of male and female connector coupling, connectors can be positively brought into mating engagement without being subject to tilting or jolting.

Especially, when the cover comprises a frame portion formed of a rectangular frame structure and a lid portion connected to the frame portion through a hinge portion, it is possible to visually determine whether connectors are held in position within the connector holding member with the cover mounted to the frame member in position. This permits more precise coupling and connecting of male and female connectors.

The fact that the lever and the pin lockingly engageable with the lever are integrally attached to the holding member eliminates any need for separate members for connector coupling, resulting in decreased number of parts and greater ease of operation. Further, possible increase in cost can be avoided. The lever may be formed of same light-weight resin material as that of the holding member, and this involves no such problem as increased weight or increased space requirement.

While existing connectors may be used as con-

nectors to be held in the holding member, it is also possible to use the connectors for ordinary connecting wires when the holding member is removed. Further, according to the present invention, respective connectors are composed of single connector units and, therefore, larger-current connectors and smaller-current connectors may be used in combination to form composite connectors according to the circuit. This adds to advantage of increased degree of freedom in design.

Although the present invention has been fully described by way of examples with reference to the accompanying drawings, it is to be noted here that various changes and modifications will be apparent to those skilled in the art. Therefore, unless otherwise such changes and modifications depart from the scope of the present invention as defined by the appended claims, they should be construed as included therein.

## Claims

1. A combination connector assembly having interengageable male and female connector units (2, 7) adapted for simultaneous engagement in a condition such that plural pairs of connectors are held in position, comprising:
  - first and second holding members (1, 6) for removably holding the same number of female and/or male connectors in each other;
  - a cover (8) mounted to the electric wire receiving side of said second holding member, said cover having a hold-down portion (38) projected therefrom in such a manner that the connectors primarily held within the interior of said holding member (6) are secondarily held in position by the hold-down portion;
  - a lever (9) formed with a cam groove (10), pivotally attached to said first holding member (1); and
  - a pin (5) projected on said second holding member (6) for being lockingly received in the cam groove, whereby a pivotal manipulation of the lever with the pin brought into engagement with the cam groove permits simultaneous engagement of the plural pairs of connectors held in said first and second holding members and, at the same time, coupling of said first and second holding members to each other.
2. The combination connector assembly as claimed in claim 1, wherein said female connector units (7) adapted as wiring-harness connecting connectors each having the same configuration are removably fitted in position in said second holding member (6), with their front ends pressed by means of the cover toward the first holding mem-

ber (1), and wherein the other male connector units (2) adapted as printed board connecting connectors are held in said first holding member serving as a connector housing (1), the members of said male connector units (2) being integrally formed with said connector housing for receiving tabs projected from the printed board.

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3. The combination connector assembly as claimed in claim 1, wherein said cover comprises a frame portion composed of a rectangular frame member and a lid portion connected to the frame portion through a hinge portion, the frame portion including a hold-down portion (50) formed in the interior thereof and projections (51) formed on the outer periphery thereof, the lid portion having locking arms (52) engageable with the projections (51), one opening of the frame portion being closable by the lid portion.

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4. The combination connector assembly as claimed in claim 1, wherein the holding members, the connector housing, and the lever are formed of a light-weight resin material.

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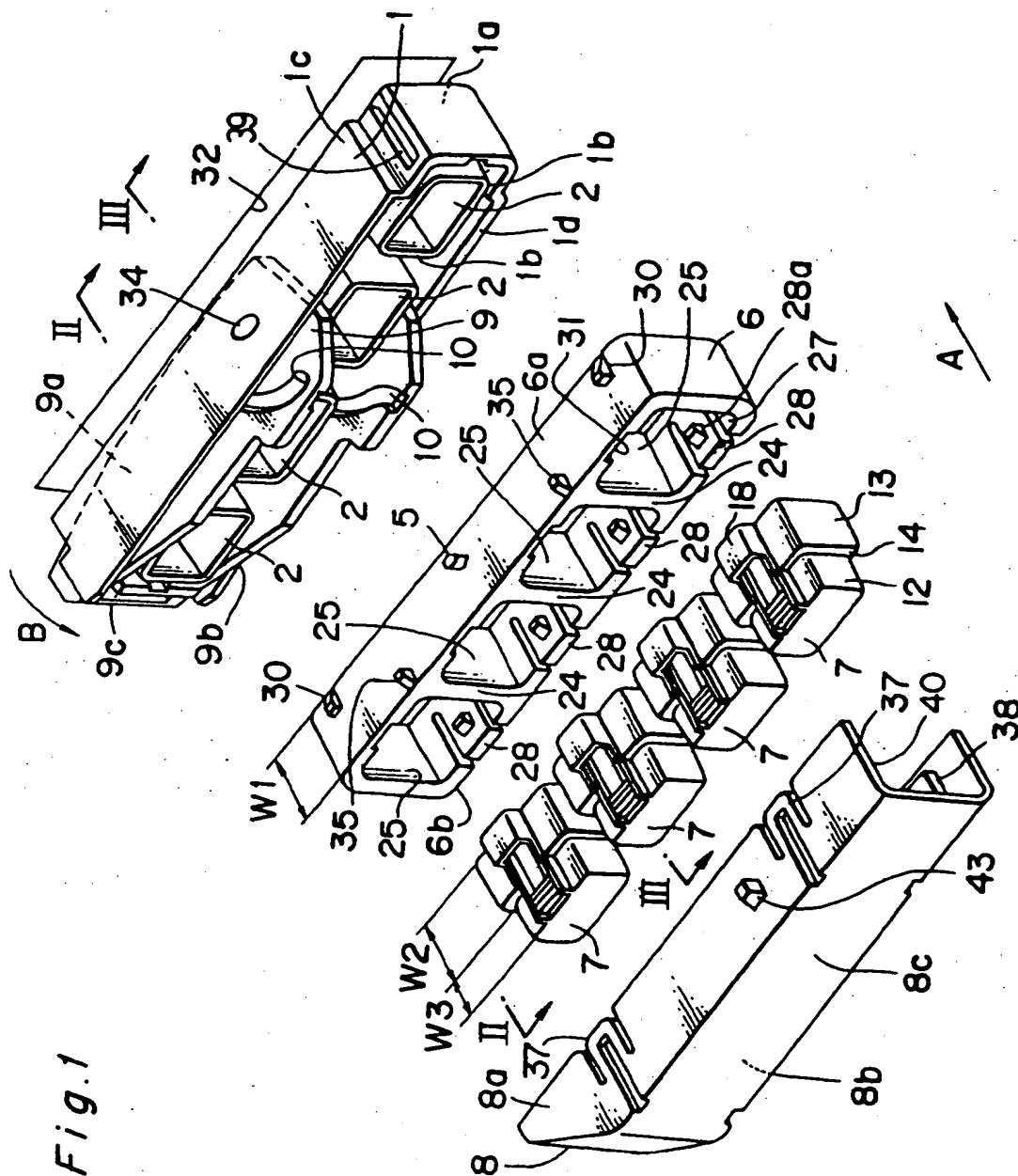


Fig. 1

Fig. 2

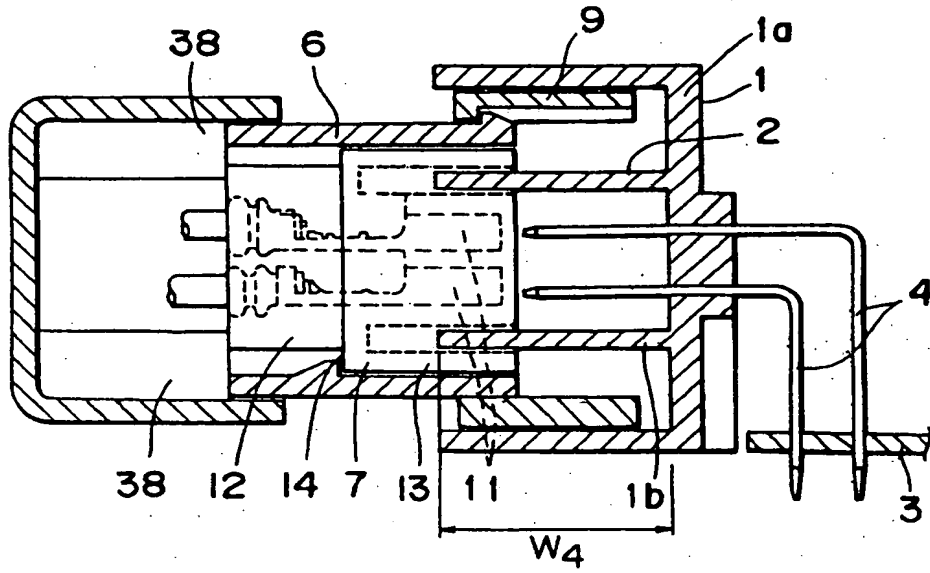


Fig. 3

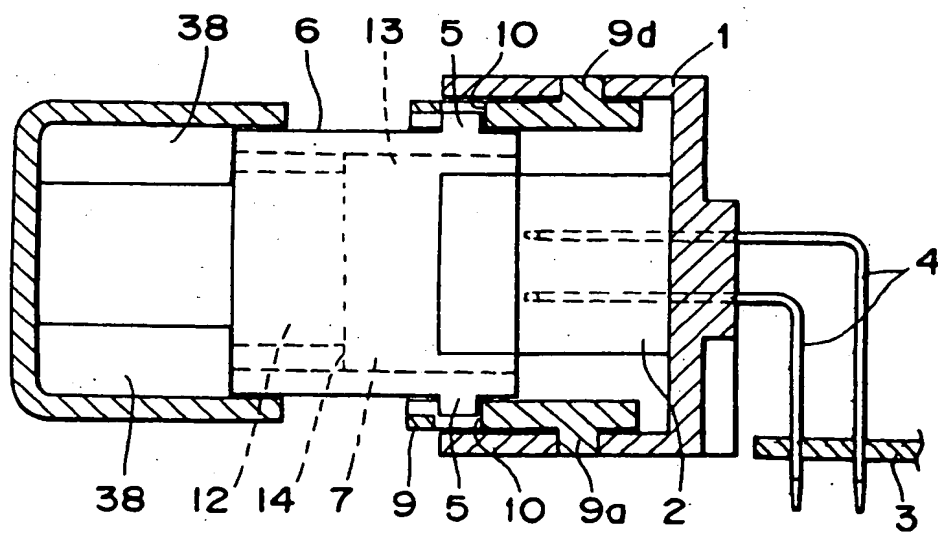
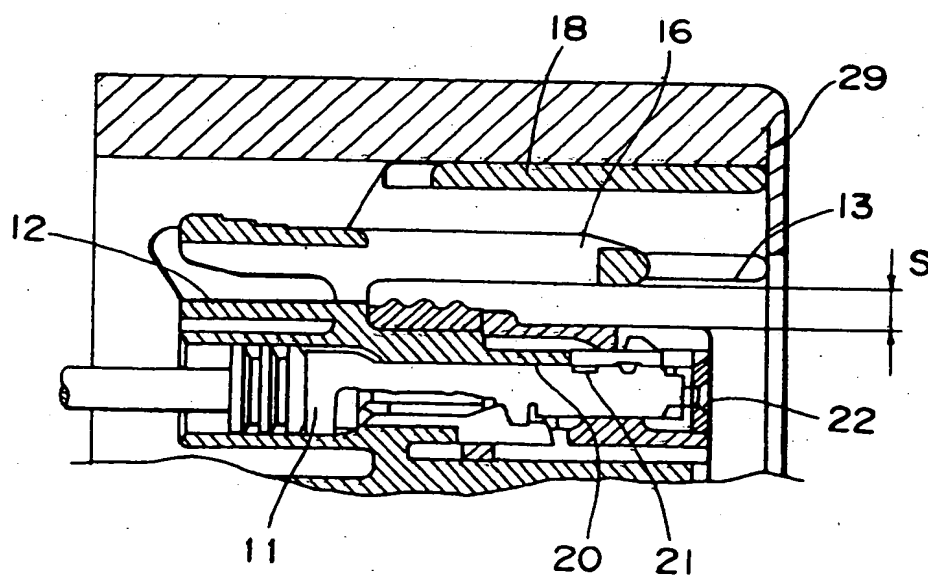
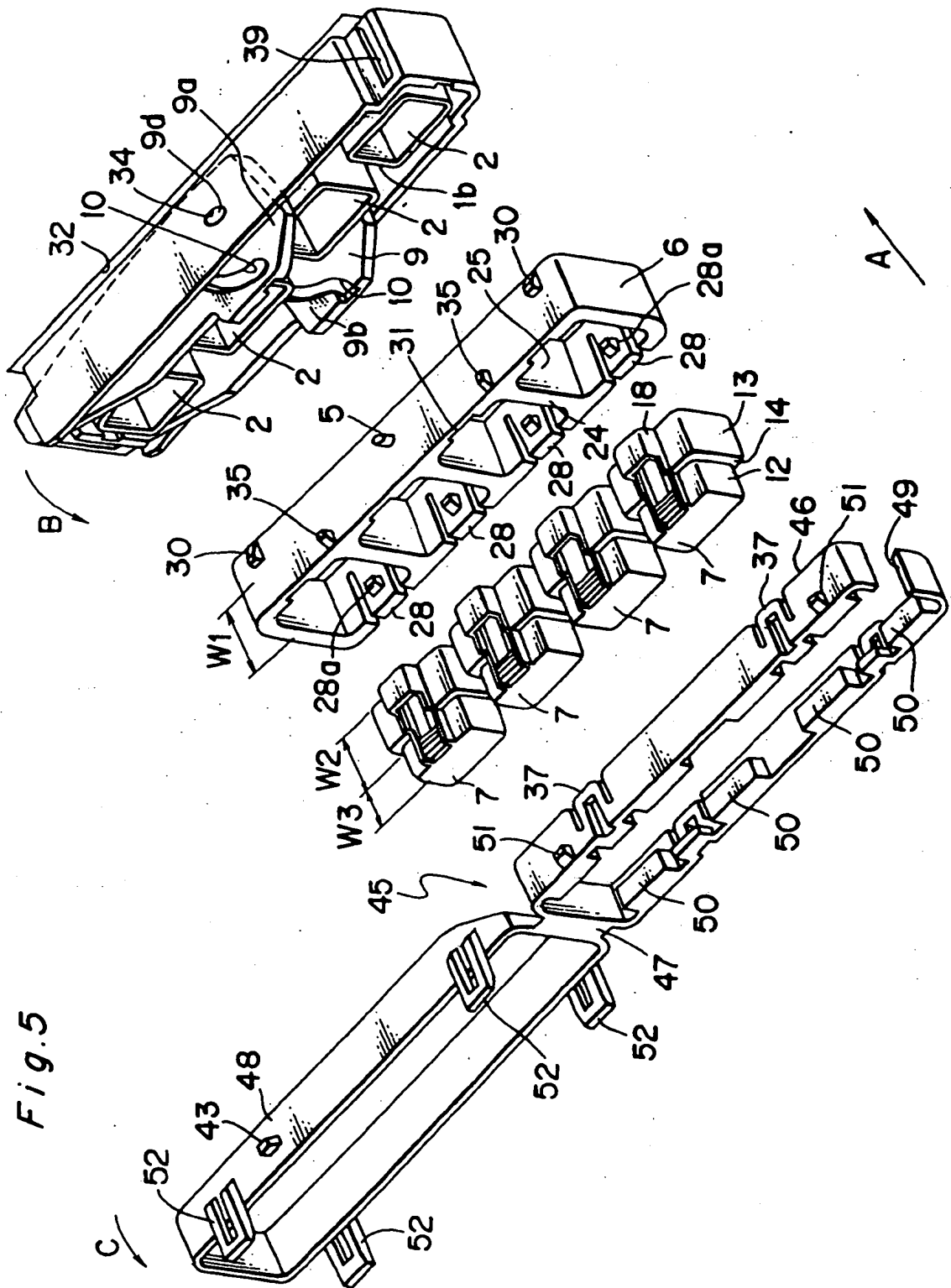




Fig. 4







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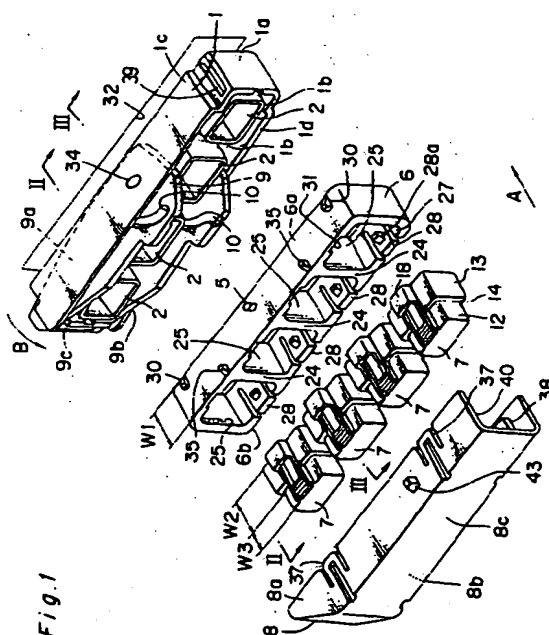
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# EUROPEAN SEARCH REPORT

Application Number  
EP 92 31 1821

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
Y	US-A-2 535 031 (JOHN W. BEATTY) * column 2 - column 4, line 66; figures 1-10 *	1,2	H01R13/62 H01R13/436
Y	EP-A-0 459 448 (SUMITOMO WIRING SYSREMS, LTD.) * page 3, column 8, line 26 - page 13, column 24, line 50; figures 1-31 *	1,2	
A	DE-A-15 15 906 (INTERNATIONAL STANDARD ELECTRIC CORP.) * page 4, last paragraph - page 7; figures 1-4 *	1,3	
A	FR-A-1 517 332 (AMP INCORPORATED) * the whole document *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			H01R
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 3 November 1993	Examiner TAPPEINER, R
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